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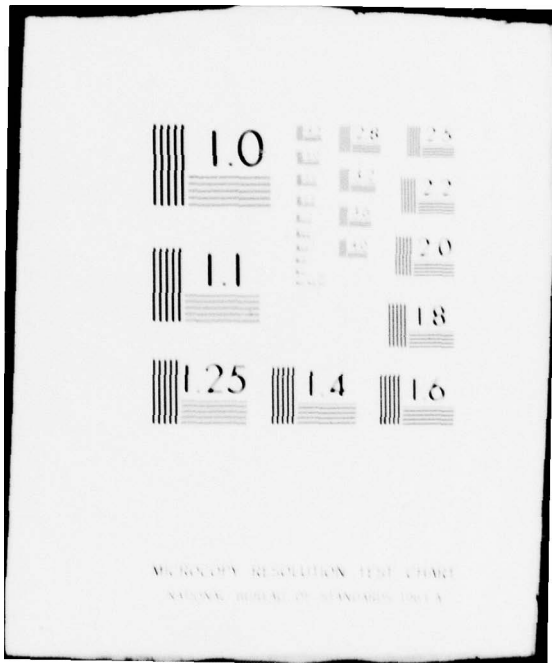
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Report 2272

CARGO CONTAINER INSERT PROGRAM

by

Claire L. Orth

April 1979

U.S. ARMY MOBILITY EQUIPMENT
RESEARCH AND DEVELOPMENT COMMAND
FORT BELVOIR, VIRGINIA

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The cargo container insert program conducted by MERADCOM was initiated in fiscal year 1976 to identify characteristics for a container insert. Basic requirements included 4000-pound-capacity, weather-resistant, lightweight, and reusable features. The program involved a survey of both commercial manufacturers and Military users. One prototype insert type was procured and tested prior to program termination.

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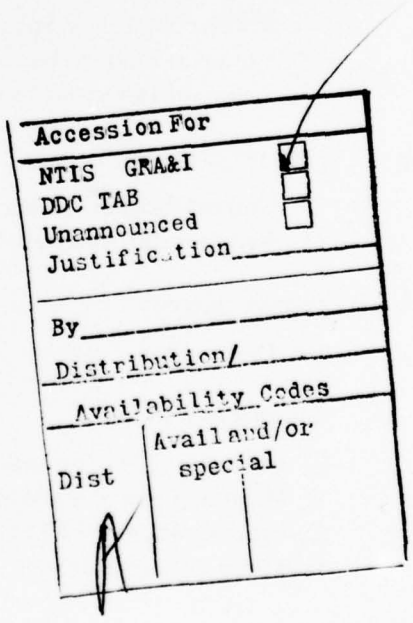
PREFACE

Work on this program was done under Project Number 1L763726DG1406, "Unitization Equipment."

Analysis of commercial data and Military Standards for Consolidation Boxes was conducted by Ms. Claire L. Orth, Project Mechanical Engineer, MERADCOM, and 1LT Frederick K. Schmidt, CE, USAR.

One prototype rotationally molded, pallet-size container insert was tested at the MERADCOM Test Area. Mr. Aubrey Thomas, Jr., was in charge of the test team.



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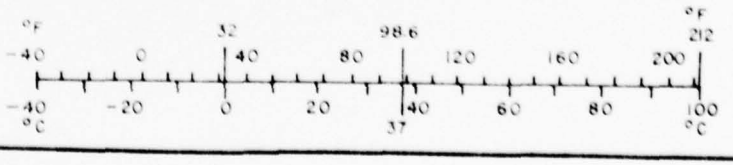
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	metric tons	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	L
pt	pints	0.47	liters	L
qt	quarts	0.95	liters	L
gal	gallons	3.8	liters	L
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

* 1 in = 2.54 cm (exactly)

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10 000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	metric tons (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
L	liters	2.1	pints	pt
L	liters	1.06	quarts	qt
L	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



CARGO CONTAINER INSERT PROGRAM

I. INTRODUCTION

1. **Background.** The U.S. Army Mobility Equipment Research and Development Command (MERADCOM) initiated a container insert program in FY76 as an outgrowth of the modular container program. At the same time, the U.S. Army Training and Doctrine Command (TRADOC) was conducting a study on the need for intermediate-size containers. The study by TRADOC was the result of a need to standardize container sizes in the Military to optimize the supply system.

2. **Joint Services Meeting.** A meeting 29-30 April 1975 was attended by a MERADCOM representative, the DOD Project Manager for Surface Container Supported Distribution Systems, and other Army, Navy, and Marine personnel to discuss various container studies and to determine the feasibility of joint services use of pallet-size containers. The Marine Corps' Container Study showed a need for pallet-size containers to be handled by the Fleet Marine Force and then moved to forward areas. The requirements for the Marine Corps pallet-size container differed from the requirements of the INTERCON study in that the Marine Corps container would need to have the capacity to hold six Marine Corps mount-out boxes and for the containers to be coupleable in a 2-by-2-by-2 array. The size, gross weight, and handling requirements were essentially the same for both types of pallet-size containers.

At the meeting, the U.S. Army Logistics Center (LOG Center) representative discussed their study of intermediate-size containers. The final report had not yet been approved; however, preliminary findings were that the Army had a need for a pallet-size container. The Army did not have a requirement for coupling the containers (which would require corner fittings) or for mount-out boxes.

MERADCOM transferred funds in September 1975 to the Civil Engineer Laboratory (CEL), Port Hueneme, California for work on the Marine Corps PALCON Project. The Pallet Container System Definition Paper, October 1975, was prepared by CEL (see Appendix C). CEL awarded a contract in September 1976 to Rohr Industries, Inc. to investigate the preliminary design of at least two concepts for the PALCON. A trade-off analysis of the concepts was to be performed by CEL prior to fabrication because of the high cost of hard tooling.

The PALCON system is a pallet-size container capable of being coupled in various arrays. The container is also capable of accepting standard mount-out boxes. The target cost of the container without trays and in large lots is $350.

The contractor's final report, "PALCON (Pallet Container) Preliminary Design Study," was prepared in April 1977. According to CEL, the results indicate that one of the concepts, Concept 2, was theoretically feasible and desirable with regard to performance and economy; therefore, CEL was continuing with that concept. The contractor estimated the cost would be around $433 per insert; the total weight, around 267 pounds.

3. **Army Meeting with the DOD Project Manager**. The DOD PM called a meeting of MERADCOM and LOG Center representatives on 13 May 1975 to discuss the Army insert program. A LOG Center survey of users revealed no need for the TRICON (intermediate-size container); however, there was interest in a pallet-size insert. With such an insert, a unit's supplies could be packed into the inserts, loaded into the 20-foot containers, then unloaded and transported to the forward area without unpacking the insert. The desired characteristics of the pallet-size insert were discussed. These characteristics are given in Appendix A along with the Marine Corps PALCON requirements.

4. **INTERCON Study**. The need for a new type of cargo container insert was identified in the INTERCON Study, ACN 22874, April 1976, by Headquarters U.S. Army Training and Doctrine Command. Section 2-12 of the study dealt with the concept for utilization of container inserts. The study determined that no need existed for an intermediate-size container; however, the container insert showed promise. Users were surveyed by TRADOC for reaction to a pallet-size container insert. Response was favorable because the units could receive supplies in the insert which could be handled easily by available equipment. The insert could also be used for both indoor and outdoor storage if the inserts were weather-resistant. The criteria identified in the study for an insert are:

a. 40-inch by 48-inch base, 41-inch height.

b. Environmental protection providing the capability of surviving 2 weeks of adverse weather.

c. Capable of two-high stacking.

d. 1500-pound capacity.

e. Capable of being sling-loaded, picked up by a wrecker, and lifted from the base by material handling equipment (MHE).

Conclusion 3-11 of the INTERCON Study is: "Determination of the optimum characteristics of an improved container insert, or family of inserts, for use

in unit deployments and resupply operations should be pursued by USAMC and TRADOC."

Recommendation 4-3 of the study is: "That a joint TRADOC/USAMC working group be established to prepare a Letter of Agreement (LOA) for the design, development, and testing of an improved container insert, or family of inserts, for use in unit deployments and resupply operations."

II. INVESTIGATION

5. **Scope**. The insert investigation consisted of four parts: Hardware, Review of Military Specifications, Survey of Military Use, and Survey of Industrial Use.

6. **Hardware**. Past efforts dealing with rotationally molded containers were for a TRICON size (8- by 8- by 6-2/3-foot) container. This size container required that a metal framework and corner posts be encapsulated in the polyethylene material. The Boeing Company, Renton, Washington, had a contract with MERADCOM to design and fabricate six TRICON-size containers. Numerous attempts were made to encapsulate the metal framework into the scaled-down containers. This process was beyond the state-of-the-art; therefore, no hardware was fabricated. A final report, "Rotationally Molded Plastic TRICON Containers," was prepared by Boeing in October 1972.

An unsolicited proposal was received from Hollowform, Inc., of Woodlawn Hills, California. This proposal was for the engineering and fabrication of eight rotationally molded pallet-size container inserts.

MERADCOM decided to procure a small number of inserts of this type for test and evaluation to determine if the rotationally molded inserts provided any improvement over the existing consolidation boxes described by Military specifications.

A contract for $25,749 was awarded to Hollowform, Inc., on 8 April 1976 to design and fabricate eight rotationally molded pallet-size container inserts ($11,000 of this for soft tooling).

The material for rotational molding was high-density, crosslinked polyethylene. According to Hollowform, this material was chosen for its stress resistance. The material has a small shrink factor, is non-toxic, is fire-resistant (but is classified as an irritant when it "burns"), has a density of 0.92 lb/ft^3, is inexpensive (approximately $1/lb in production), and will meet the corner drop tests of MIL-STD-810.

The design of the insert incorporates a removable lid which allows insert entry from the top and also half way down one side. The lid is secured to the insert by

means of four cargo straps. Fiberglass stiffeners are riveted into the corners of the insert to provide strength when inserts are stacked. A ½-inch-thick plywood floor is provided. The base is part of the insert and permits four-way entry for fork tines. A molded-in stacking feature is provided to ensure that the inserts will not slip when stacked. The insert is not collapsible.

Eight inserts were fabricated by Hollowform, Inc., and delivered to MERADCOM in November 1976. The weights of the inserts varied from 150 to 154 pounds. The inside dimensions are 45 by 38 by 36 inches high. The volume is 35.6 cubic feet. The prototypes are shown in Figures 1, 2, and 3.

The contractor conducted quality control (percent of gel) tests, stacking tests with fully loaded containers, and a simulated helicopter sling test. The contractor recommended some revisions as a result of their testing. The top lid fit was tight due to greater shrinkage of the top than was predicted. This could be corrected with slight tooling changes. The top lid also exhibited warpage, which can be eliminated with the addition of depressed ribs to strengthen the panel. Stacking of the container inserts is accomplished by the mating of four round, raised bosses in the lid with four depressed bosses in the container bottom. Alignment of the inserts could be accomplished quicker if more clearance were provided. Glass-reinforced structural member can be incorporated into the side walls to eliminate the side wall deformation when inserts are stacked.

Tests conducted by MERADCOM included inspection (size; weight), movement, loading, stacking, and a 6-month weather exposure test. Four of the inserts were loaded to 2300 pounds with clean construction sand. Some bulging of the insert sides occurred because of the sand load. This bulging was not enough to interfere with loading the inserts within a MILVAN container. Additional bulging occurred when one insert was stacked on top of another insert. A total of 10 hours of moving the inserts into and out of a MILVAN container and stacking the inserts was conducted. The only problem encountered was failure of the banding straps. This was a result of the placement of the straps. The fork tines caught the straps of the bottom insert when engaging the fork pockets of the top insert during stacking operations. This catching was promoted when the bottom container lid depressed on stacking, exposing the banding straps.

With the exception of the cargo tie straps, the container insert functioned well. Some minor design changes would enhance its performance.

On 3 October 1977, a call was received from Mr. Fred Dohm, Defense Logistics Agency Headquarters (DLA), concerning the MERADCOM container insert program. They were looking for a 40- by 48-inch base collapsible plastic container

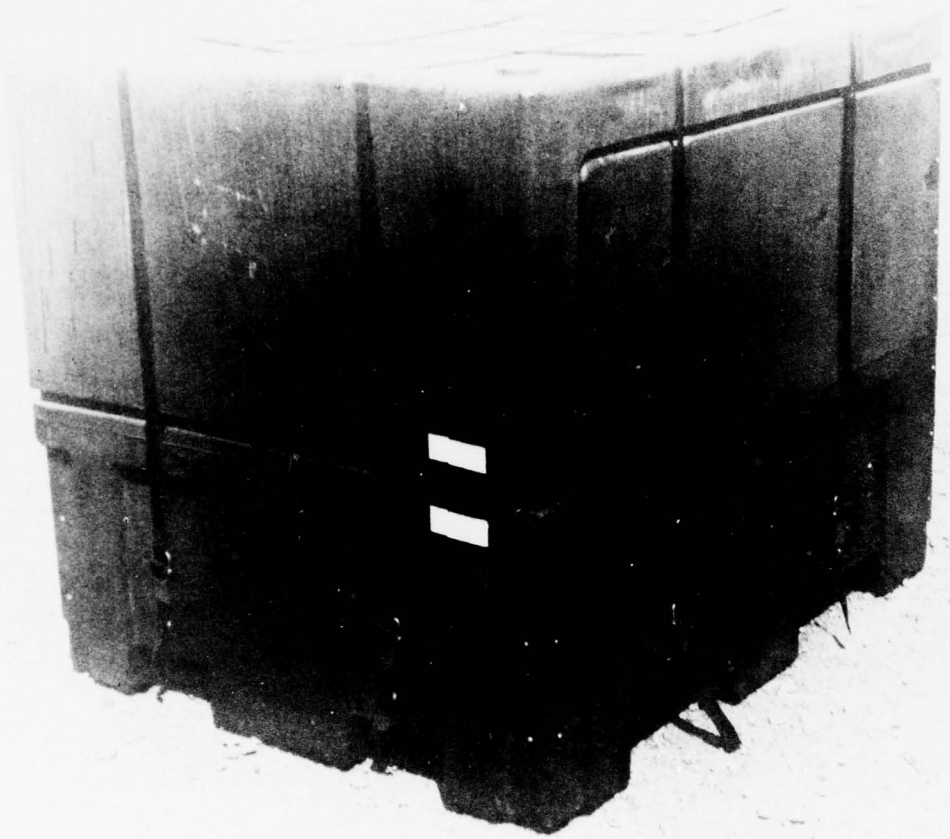


Figure 1. Hollowform 40- by 48- by 41-inch insert with lid and banding straps.

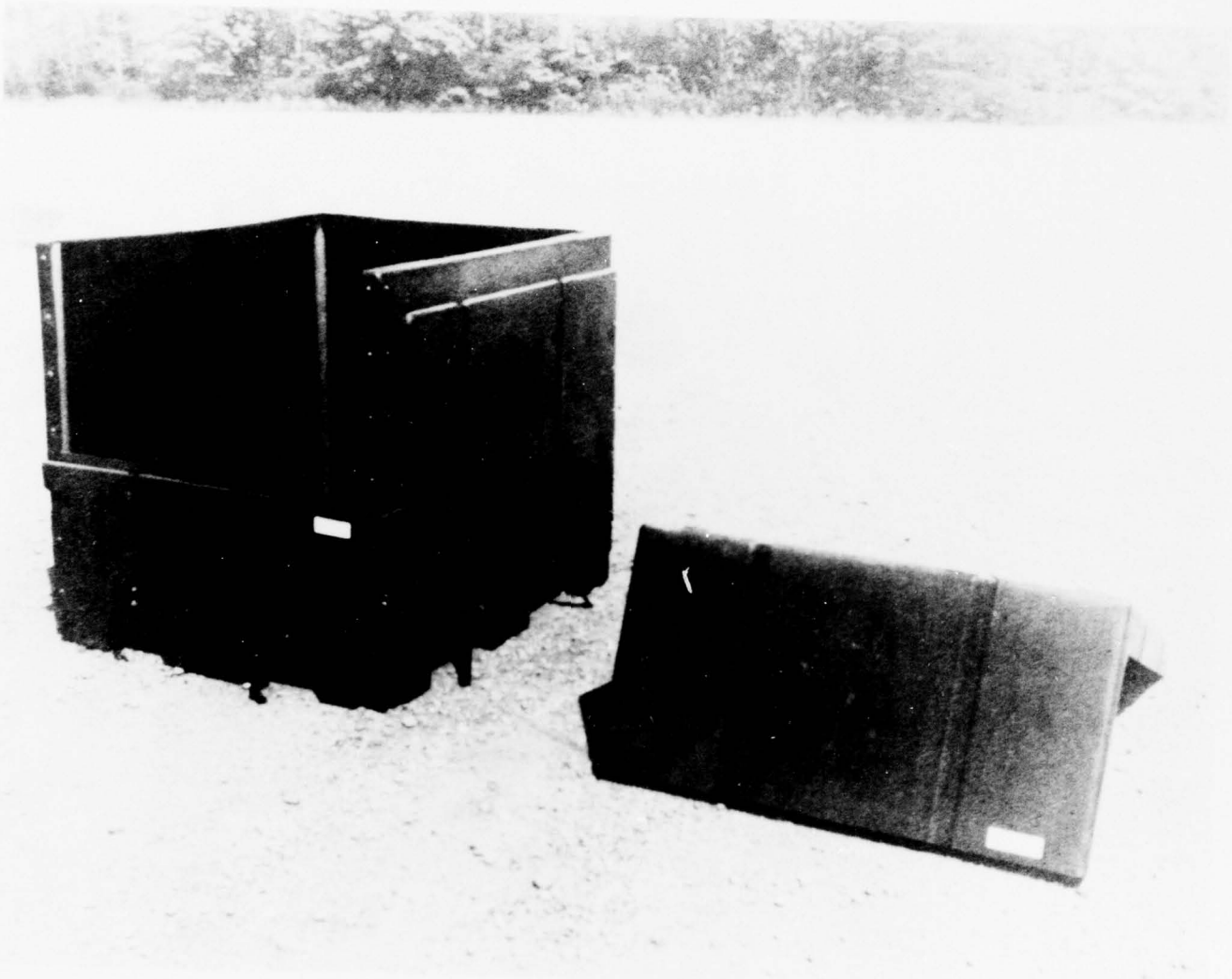


Figure 2. Hollowform insert with lid removed

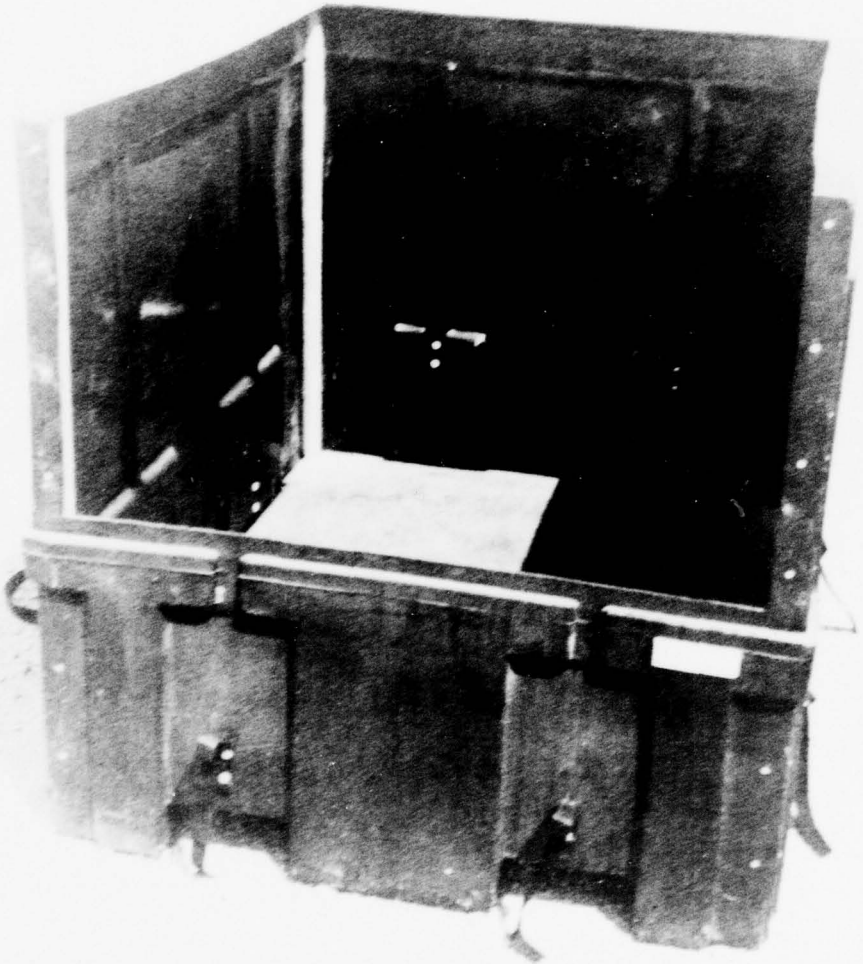


Figure 3. Hollowform insert with lid removed, showing wooden floor

with hollow legs to be used to air lift perishable fruits and vegetables to Saudi Arabia. Problems had been encountered with the tri-walled container currently being used. The bags of dry and wet ice used to keep the cargo cold sometimes broke inside the container and damaged other containers and the contents.

Three DLA representatives visited the MERADCOM North Annex on 18 November 1977 to inspect the eight rotationally molded container inserts and to discuss the possibility of using these inserts in a test shipment. Even though our inserts were not collapsible, the representatives wanted to test them in an air lift from the Camden Refrigerated Terminal, New Jersey to Saudi Arabia, throughout Saudi Arabia, and return. The eight inserts were sent to DLA on 12 December 1977. Because of lack of funds, DLA was unable to test the inserts.

7. **Review of Military Specifications**. MERADCOM's program included the review of existing Military specifications for consolidation boxes to determine if these boxes would meet any or all of the requirements for a container insert.

Military inserts (consolidation boxes) are presently employed within the Army supply system. These inserts are pallet-size and smaller and are described in both size and construction by Military Standard MIL-STD-1187 and Military Specification MIL-B-43666B. Environmental protection to these containers is not specified in either document, and the material specified does not provide environmental protection.

Military Standard MIL-STD-1187 (23 Mar 76) specifies the dimensions and composition of boxes to be used on a 40- x 48-inch standard pallet. The five sizes range from 24 inches long by 20 inches wide by 18 inches high to 48 inches long by 40 inches wide by 36 inches high. The materials specified are: Paperboard, wirebound wood, cleated plywood, nailed- and cocked-corner wood, fiberboard, and triple-wall corregated fiberboard.

This standard is useful for sizing boxes to be used on standard four-way DOD pallets. These boxes provide convenient packing of standard pallets for shipping nonhomogeneous supplies.

Specification MIL-B-43666B (29 June 73) deals with the sizes, construction, and use of palletized container inserts made from plywood and fiberboard. These boxes have pallets specified for their sizes; i.e., not all are the standard 40- by 48-inch base. The chosen sizes are compatible within themselves but do not give the maximum efficiency in container loading.

8. **Survey of Military Use**. MERADCOM planned to conduct a user survey of field units to determine the need for a container insert with the following characteristics.

a. 40-inch by 48-inch base; 41-inch height.
b. Four-way fork entry.
c. Capable of outdoor storage.
d. Easy to load/unload.
e. Lightweight.
f. Stackable.
g. Reusable.

The PM for Army Container Oriented Distribution Systems (PM ACODS) had requested various Army elements to input their design considerations into the overall insert study. The PM's letter, dated 11 February 1976, was sent to depot organizations which, in peace time, usually deal in full container lots (single consignee). The user in the field was not queried as to the usefullness of a container insert.

9. **Survey of Industrial Use.** Numerous commercial manufacturers of inserts and containers were contacted for information on their products. Many manufacturers will make containers and boxes to meet the customer's dimensional requirements. There is a wide range of materials available: Steel, corregated cardboard, cleated plywood, wire-bound wood, fiberboard, triple-wall corregated fiberboard, and plastic.

Most of these containers are not suitable for outdoor storage. The sizes range from tray to pallet to multi-pallet dimensions. Industrial inserts are widely accepted in shipping and storage (warehouse). A partial list of commercial manufacturers of metal containers conforming to MIL-STD-1187 is contained in Appendix B, which also contains a partial list of manufacturers of small-size containers.

III. DISCUSSION

10. **Current Program Status.** Since an LOA had not yet been prepared by TRADOC on the Container Insert Program, MERADCOM initiated efforts to prepare a Letter Requirement (LR) and a Development Plan (DP). While information was being gathered for these documents, it was learned that TRADOC had deleted this item because there was no longer a requirement for container inserts as previously defined. During his active duty assignment, 1LT Frederick K. Schmidt investigated the chronology of events leading to the termination of this program. His report is in Appendix D.

11. **Requirement Analysis.** Emphasis in the Army has been on unitization of supplies. Unitization provides a more effective means to stuff and strip containers and for more rapid and efficient handling. The standard DOD four-way pallet has been used extensively because it is a convenient size that is compatible with the 8-foot-wide family of containers and with the Air Force 463L air-transport pallet. The pallet is

easily handled by 4000-pound-capacity forklift trucks, and pallet slings are available for air (sling) movement.

According to the INTERCON Study, the 40- by 48-inch pallet ranks third in efficient use of floor space in the 40-foot-long containers (90.8 percent). About 70 percent of the Army's tonnage is shipped on 40- by 48-inch pallets. Also 78 percent of a division's equipment is less than or equal to 10 cubic feet in volume and can go on a 40- by 48-inch pallet. The study contained no information on the dimensions of the equipment. The 40- by 48-inch size pallet is used because it is efficient, it is accepted internationally, and most storage depots are designed for this size pallet. Weather protection is provided in many instances by shrink film.

It is envisioned that 20-foot containers will go to the General Support Unit (GSU) level, then be stripped and the contents sent forward by other means. This process could result in loss of items. If each container insert were loaded with items for a single field unit, when the container reached the GSU the inserts could be unloaded and sent forward without the need for extra environmental protection. The insert could also be used to store the supplies inside or outside. The 40- by 48- by 41-inch size would permit handling by conventional means. If a forklift truck were not available to move the loaded insert, a side access and/or removable top would permit manual removal of the contents. The empty insert could be moved by two people. The container insert with a locking mechanism would provide more security than present pallets with shrink film. The inserts should be collapsible for easier retrograde.

Based upon the inside dimensions of the 8- by 8- by 20-foot ANSI/ISO containers, the optimum insert size is 45- by 44- by 41-inch. This size has a volume of 47 cubic feet and would result in the following container percent utilization:

MILVAN	88%
20-foot commercial	91%
40-foot commercial	90%

For the 40- by 48- by 41-inch insert, the following percent utilization would result:

MILVAN	77%
20-foot commercial	80%
40-foot commercial	87%

An analysis on the effect of the 45- by 44- by 41-inch insert would need to be conducted to determine if it would be cost effective to pursue this size over the standard 40- by 48- by 41-inch.

The table, page 11, analyzes the space utilization of the MIL-B-43666 container inserts in the MILVAN and in 20-foot and 40-foot commercial containers.

Percent Container Cube Utilization for Various Insert Sizes

Container Insert				MILVAN		20-Foot Commer.		40-Foot Commer.	
Length (in.)	Width (in.)	Height (in.)	Cubic Feet	Array	Percent	Array	Percent	Array	Percent
86	31.75	41	64.8	2x2x2	48.7	2x2x2	50.4	2x2x5	62
57	31.75	41	42.9	2x2x4	64.5	2x2x4	67	2x2x8	66
43	31.75	41	32.4	2x2x5	61	2x2x5	63	2x2x10	62
31.75	43	41	32.4	2x2x7	85	2x2x7	88	2x2x14	87
29	31.75	41	21.8	2x2x7	57	2x2x7	59	2x2x16	67
31.75	29	41	21.8	2x3x7	86	2x2x7	60	2x2x14	59
58	43	41	59.2	2x2x3	67	2x2x3	69	2x2x8	91
86	31.75	20.5	32.4	4x2x2	49	4x2x2	50	4x2x5	62
57	31.75	20.5	21.5	4x2x4	65	4x2x4	67	4x2x8	66
43	31.75	20.5	16.2	4x2x5	61	4x2x5	63	4x2x10	62
31.75	43	20.5	16.2	4x2x7	85	4x2x7	88	4x2x14	87
29	31.75	20.5	10.9	4x2x7	57	4x2x7	59	4x2x16	67
31.75	29	20.5	10.9	4x3x7	86	4x2x7	60	4x2x14	58
58	43	20.5	29.6	4x2x3	67	4x2x3	69	4x2x8	91

IV. CONCLUSIONS

12. **Conclusions.** It is concluded that:

a. A collapsible insert is preferred because it can be knocked down for retrograde. The PALCON is not collapsible.

b. A weather-resistant or weatherproof container insert would permit wider use and storage of unit shipments of supplies.

c. The optimum size insert for container cube utilization is 45 by 44 by 41 inches. Further study of this size insert is needed to determine the effect, if any, on the distribution system.

d. A container insert of the size 40 by 48 by 41 inches would cause no problems in the distribution system. This is the same size as the standard DOD four-way pallet which is accepted internationally.

e. Any container insert must be compatible with the MILVAN and 20-foot and 40-foot ANSI/ISO containers as well as the Air Force 463L pallet.

f. The Hollowform, Inc., rotationally molded pallet-size container insert performed adequately. Some minor design changes would enhance its performance. This insert is not collapsible, which is a major drawback. The cost of this insert in production would be about $150 to $200 each.

APPENDIX A

CHARACTERISTICS FOR ARMY PALLET-SIZE CONTAINER INSERT

1. 40- by 48- by 41-inch with four-way fork pocket entry.
2. Inexpensive: $100 to $150 each.
3. Reusable.
4. Weatherproof.
5. Lightweight (around 100 pounds).
6. Fire-resistant.
7. Removable top and 48-inch side for easy access.
8. Corrosion-resistant.
9. Puncture-resistant.
10. Olive-drab color.
11. Stackable, three high.
12. 2500-pound capacity.
13. Rodent- and insect-proof.
14. Liftable by helicopter.

CHARACTERISTICS OF MARINE CORPS PALLET-SIZE CONTAINER

1. Size: 40- by 48- by 41-inch.
2. Capacity: Hold six mount-out boxes (17- by 45- by 10-inch).
3. Coupleable in a 2-by-2-by-2 array.
4. Set of doors on the 40-inch side.
5. Tare weight: 200 pounds.
6. Gross weight: 1600 pounds.
7. Service life: 5-year.
8. Transportable by helicopter.
9. Four-way fork pockets.

APPENDIX B

MANUFACTURERS OF VARIOUS SMALL CONTAINERS

PARTIAL LIST OF MANUFACTURERS OF METAL CONTAINERS

CONFORMING TO MIL-STD-1187 (1976)

W. D. Adams Co., Inc.
Atlant Corporation
Barnes & Reinecke, Inc.
Container Research Corp.
Container Systems Corp.
Dorsey Trailers, Inc.
Fruehauf Corporation
McKenzie Eng. Co.
MIRAN (Metal Container Div.)
NVF Co.
Rohr Industries, Inc.
Strick Corp.
Trailmobile Pullman Inc.
Al Young Ind., Inc.

Some Manufacturers of Small Size Containers

Company	Sizes	Side Access	Material	Collapsible
Air Con Systems	Various	Yes	Thermo Plastic	Yes
Chicago Mill & Lumber Co.	Various & Custom		Cleated-Plywood & Wire-bound	Yes
Containair Systems Corp.	Various	Yes	Triple-Walled Fiberboard	Yes
Fenton Manufacturers Service	Custom		Roto Cast Polyethylene	Doubtful
General Box Division, Southwest Forest Industries	Various		Wirebound	Yes
Global	40"x48"x28"	No	Vacuum-Formed Poly-ethylene	Nestable
Hollowform, Inc.	Custom		Polyethylene	Doubtful
Liberty Industries	Custom		Wood, Wirebound Corregated	
Menasha Corporation	Various		Buckboard Pallets with Container	
Myton Industries	17.45 ft^3		Plastic	
NVF Company	Various	Yes	Heavy-Duty Steel Vulcanized Fibre Plastic	
Package Research Laboratory	MIL-B-43666 Various & Custom	Yes	Wirebound Plywood	Yes

Some Manufacturers of Small Size Containers (Cont'd)

Company	Sizes	Side Access	Material	Collapsible
Palletower, Inc.	Various & Custom		Braced, Mesh, Solid, or Rod Panels on Pallet	Yes
PDQ Plastics, Inc.		No	Structural Foam Polyethylene Trays on Pallet	
Tote Systems			Aluminum	Yes
Triton Division, Sanchez Enterprizes, Inc.	35"x42"x24" 40"x48"x24"	Yes	13-Gauge Steel	

APPENDIX C

PALLET CONTAINER (PALCON) SYSTEM DEFINITION PAPER

by

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21 October 1975

INTRODUCTION

This paper is a detailed description of the Pallet Container (PALCON) System concept and is intended for use in system development. The terminology herein should provide a means of communication among individuals, from those who study needs to those who perform design. The system requirements are goals for design and are subject to minor revision as the feasibility of details is determined.

MISSION

The PALCON System consists of two components: The PALCON itself and the adaptive pallet. PALCONs are used for dry cargo, have optional inserts to achieve internal compartmentation, and can be lifted singly or coupled and lifted in arrays. Without the adaptive pallet, PALCONs are handled and transported as breakbulk cargo. With the adaptive pallet, PALCONs are handled and transported as intermodel containerized cargo.

The objective is to use a single component, common to both containerized and breakbulk systems, for containing military cargos from a point of enbarkation to the combat zone. The primary attribute is the ability to breakdown the cargo into smaller bits at various places along the way. The cargo can begin the trip in the form of 8- x 8- x 20-foot intermodel shipping containers and end the trip in the form of 48- x 14- x 19-inch trays.

CONFIGURATIONS

There are 12 system configurations as shown in Table C-1. Configuration 1 is a single insert tray, Configuration 2 is a single PALCON with or without trays. Configurations 3 through 9 are PALCON arrays, Configuration 10 is the adaptive pallet without PALCONs, and Configurations 11 and 12 are PALCON arrays on the adaptive pallet. There are other possible configurations, such as PALCONs in closed van containers and out-sized cargo on the adaptive pallet, but these are not normal configurations and are not part of PALCON system concept.

COMPONENTS

The PALCON component consists of six basic elements:

1. The weathertight box structure to protect the contents.
2. Eight corner fittings for lifting and restraint.
3. Latching hardware used in conjunction with the corner fittings for coupling.
4. An integral pallet base with tineways for forklift handling.

Table C-1. Configurations, Dimensions, and Weights

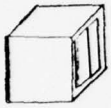
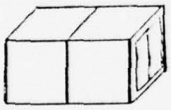
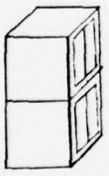
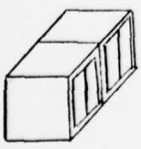
Configuration	Dimensions (in.)			Gross Weight Rating (lb)
	Width	Height	Length	
Insert Tray  1	48.00	15.66	19.37	200
Single FALCON  2	48.00	41.00	38.75	1,800
Two-Wide Array  3	96.00	41.00	38.75	3,600
Two-High Array  4	48.00	82.00	38.75	3,600
Two-Long Array  5	48.00	41.00	77.50	3,600

Table C-1. Configurations, Dimensions, and Weights (Cont'd)

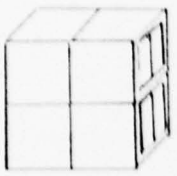
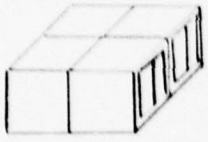
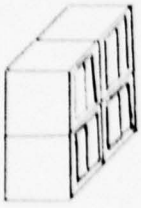
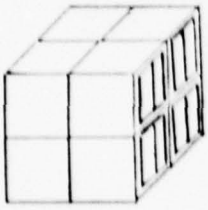
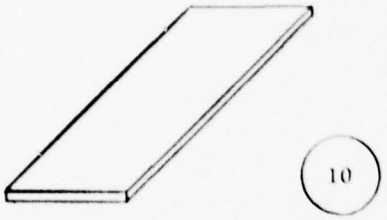
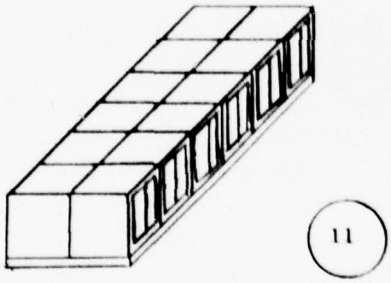
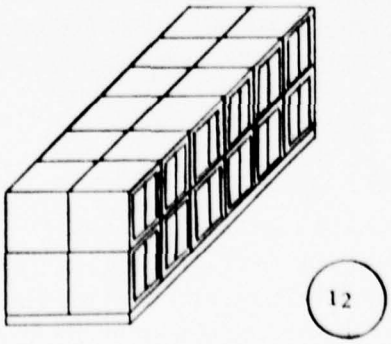
Configuration	Dimensions (in.)			Gross Weight Rating (lb)
	Width	Height	Length	
Two-Wide and Two-High Array  6	96.00	82.00	38.75	7,200
Two-Wide and Two-Long Array  7	96.00	41.00	77.50	7,200
Two-High and Two-Long Array  8	48.00	82.00	77.50	7,200
Maximum Array  9	96.00	82.00	77.50	14,400

Table C-1. Configurations, Dimensions, and Weights (Cont'd)

Configuration	Dimensions (in.)			Gross Weight Rating (lb)
	Width	Height	Length	
Adaptive Pallet Without Payload  10	96.00	14.00	238.50	1,600
Maximum Single-Layer Extended Array  11	96.00	55.00	238.50	23,200
Maximum Extended Array  12	96.00	96.00	238.50	44,800

5. A side door for stuffing and unstuffing.
6. Six optional insert trays for cargos requiring bins.

In this paper, "stuffing" refers to putting cargo into the PALCON, whereas, "loading" refers to putting PALCONs into or onto something else. Furthermore, the longest dimension of the tray and PALCON is defined as the width instead of the length due to orientation in Configurations 11 and 12.

The adaptive pallet component consists of five basic elements:

1. The flat pallet structure for redistributing loads.
2. Cargo restraint hardware to receive the PALCONs.
3. Four corner fittings for lifting and restraint.
4. Tineways for forklift handling.
5. Slots for straddlelift handling.

The adaptive pallet functions as a special type of open-frame container by interfacing breakbulk cargo with containerized cargo handling and transportation equipment.

ARRAYS

A PALCON array is two or more PALCONs coupled together by means of the special corner fittings and latching hardware. The maximum array for fully loaded PALCONs handled and transported as breakbulk cargo is eight PALCONs arranged two wide, two high, and two long, and this specific configuration is simply referred to as the maximum array. An extended array is two or more maximum arrays or two or more two-wide-by-two-long arrays on an adaptive pallet for handling and transportation as containerized cargo. The maximum extended array for full loaded PALCONs is 24 PALCONs and one adaptive pallet with the PALCONs loaded as three maximum arrays; this specific configuration is simply referred to as the maximum extended array. An assembly of 12 PALCONs and one adaptive pallet with the PALCONs loaded as three two-wide-by-two-long arrays is referred to as the maximum single-layer extended array. The two-wide-by-two-long array, maximum array, maximum single-layer extended array, and maximum extended array are depicted in Table C-1 as Configurations 7, 9, 11, and 12, respectively.

WEIGHTS

Gross weight ratings are 200 pounds for the insert tray, 1,800 pounds for the PALCON, and 44,800 pounds for the maximum extended array. Therefore, maximum allowable tare weights are 600 pounds for the PALCON without trays and 1,600 pounds for the adaptive pallet. Gross weight ratings for each configuration are listed in Table C-1.

DIMENSIONS

The maximum array is nominally 8 feet wide for compatibility with various vehicles, 6-10/12 feet high due to overhead clearances in amphibious ships, and 6-8½ feet long for transport on the Marine Corps logistic trailer in place of a triple container (TRICON). Therefore, the maximum array is an assimilated 1E container, as defined in American National Standards Institute (ANSI) "ANSI MH5.4-1972," of nonstandard height and nonstandard gross weight rating. The base is configured as near as practical to the ISO 1E container (TRICON) for maximum use of container handling equipment. The actual dimensions of the base are 96 inches and 77.50 inches. The actual height is the same as the nominal height, 82 inches.

An individual PALCON is nominally 4 feet by 3-4/12 feet at the base and 3-5/12 feet high so that an array of 2-by-2-by-2 PALCONs will be the maximum array. Nominal dimensions for the insert tray are similarly derived for six trays in a PALCON arranged in two columns and three rows. The dimensions in Table C-1 for Configurations 1 through 8 are nominal dimensions based on the actual dimensions for Configuration 9. The actual dimensions of the insert tray and the PALCON are less to account for thickness of material, space between coupled units, and out-of-square tolerances.

The adaptive pallet is nominally 8 feet wide, 1-1/6 feet high, and 20 feet long so that the maximum extended array is an assimilated 1C container, as defined in "ANSI MH5.41972" with standard size and gross weight rating, but with other nonstandard limitations. The actual dimensions are shown in Table C-1.

HANDLING AND TRANSPORTATION

Recommended Modes

The recommended modes of handling and transportation for each system configuration are shown in Table C-2. The cases indicated in the table include breakbulk and container operations. Depending on the configuration and the payload, terminal operations are by hand, forklift, straddlelift, crane, and pallet hoist and transportation is by the marine, highway, rail, fixed-wing air, and rotary-wing air modes.

Empty insert trays can be stored on the ground, on a floor, on ordinary pallets, or in PALCONs and are inserted into PALCONs by hand. In the event trays are stuffed prior to insertion, they are stored on ordinary pallets and inserted by hand with forklift assistance. Empty PALCONs can be moved a short distance by hand, also, but the frequency of occurrence will depend on the lightness of tare weight achieved in system development.

Table C-2. Modes of Handling and Transporting the Various PALCONS System Configurations

System Configurations	Modes									
	Handling*					Transport*				
	Hand	Forklift	Straddlelift	Crane	Pallet Hoist	Marine	Highway	Rail	Fixed-Wing Air	Rotary-Wing Air
1. Insert Tray	▨	■		▨	▨	▨	■	▨	▨	
2. Single PALCON	▨	■		■	■	■	■	■	■	■
3. Two-Wide Array		■		■		▨	■	▨	▨	■
4. Two-High Array		■		■		▨	■	▨		■
5. Two-Long Array		■		■		▨	■	▨	▨	■
6. Two-Wide and Two-High Array		■		■		▨	■	▨		■
7. Two-Wide and Two-Long Array		■		■		▨	■	▨	▨	
8. Two-High and Two-Long Array		■		■		▨	■	▨		■
9. Maximum Array		■		■		▨	■	■	■	■
10. Adaptive Pallet		■	■	■		▨	■	■	■	▨
11. Max. Single-Layer Ext. Array		▨	■	■		▨	■	■	■	▨
12. Maximum Extended Array		▨	■	■		▨	■	■	▨	▨

* ■ Recommended as standard practice.

▨ Recommended under limited conditions.

□ Not recommended.

Forklift is the primary means of handling all breakbulk configurations in storage, stuffing, assembly, marshalling, and loading areas, with crane the secondary means, except for ship loading, where the crane is the primary means. Crane is the primary means of handling all container configurations in assembly, marshalling, and loading areas, with straddlelift a secondary means in assembly and marshalling areas. Forklift handling of container configurations is limited to empty adaptive pallets and relatively lightweight loads. Pallet hoist is the means of handling ordinary pallets and PALCONs with the LHA (a type of amphibious ship).

All configurations can be moved by all modes of transportation, but four combinations are not recommended. Insert trays on ordinary pallets by the rotary-wing air mode is undersirable due to lack of weather tightness; the trays should be carried in PALCONs in that mode. Configurations 4, 6, and 8 by the fixed-wing air mode are undesirable due to high center-of-gravity and small base for restraint in the aircraft; the same cargo can be shipped in Configurations 3, 5, and 7.

The single PALCON and the maximum array can be carried as breakbulk cargo by all modes, and a variety of helicopters can deliver all breakbulk configurations. These configurations and modes will be the main ones used in assault and assault-follow-on amphibious operations.

The maximum single-layer extended array is mainly for fixed-wing air transport and the maximum extended array is mainly for marine, highway, and rail transport. These configurations and modes will be the main ones used in sustained and subsequent operations. Transportation of container configurations by the rotary-wing air mode will be limited, because heavy-lift helicopters are required. Transportation of container configurations by the marine mode will be limited, because the extended arrays are limited in stacking, racking and lashing resistance.

Assembly for Shipment

Although many modes of handling and transportation can be used, the emphasis is on maximum use of forklift handling, the marine mode and the fixed-wing air mode for the long haul, and the highway mode and the rotary-wing air mode for short-haul delivery. The recommended procedure for the assembly of cargo for marine and air shipments is depicted in Figure C-1. As can be seen in the figure, insert tray and PALCON storage, PALCON stuffing, breakbulk cargo assembly, and container cargo assembly are identified as separate sequential operations which may occur in separate areas.

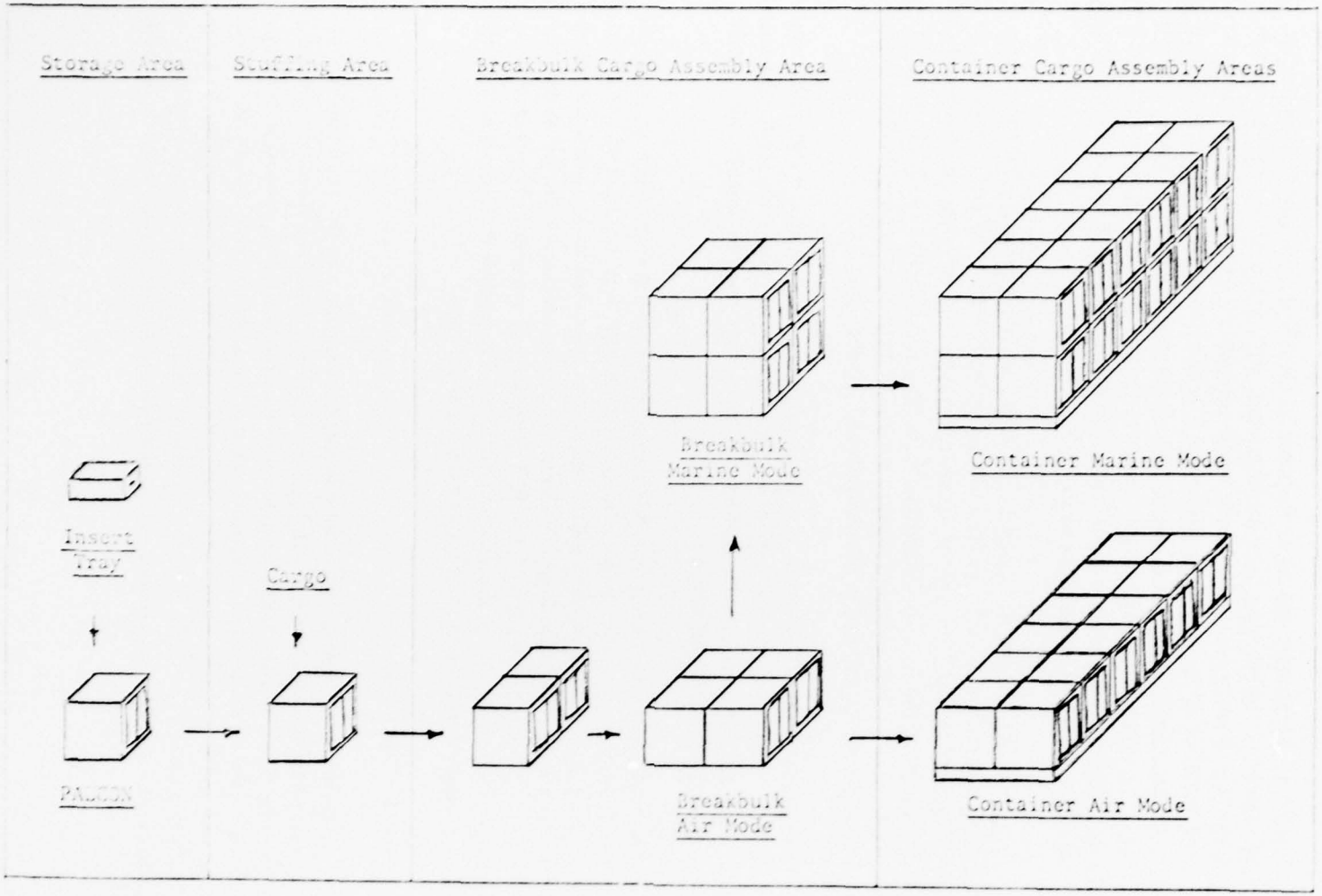


Figure C-1. Recommended Assembly Diagram for Marine and Air Shipments

Empty PALCONs and insert trays are stored in the storage area. The first step is to insert empty trays, if required, and move the PALCON to the cargo.

The stuffing area is the area where the cargo is stored. The second step is to stuff the PALCON and move it to the breakbulk cargo assembly area.

The breakbulk cargo assembly area is the area where PALCON arrays are formed. The third step is to couple two PALCONs, end-to-end, with the doors facing the same direction to form a two-long array, which is Configuration 5. Configuration 5 is better than 4, because it has a lower center-of-gravity, and is better than 3, because it is a more compact shape. It also provides the best access to the contents when storage of two PALCON arrays is desired. Configuration 4 is undesirable for building arrays for air shipments.

The fourth step is to couple two two-long arrays, side-by-side, with the doors of both facing outward to form a two-wide-by-two-long array, which is Configuration 7. At this point, Configuration 7 is transferred for loading on an aircraft as breakbulk cargo, is transferred to the assembly area for containerized air cargo, or remains to be assembled for marine shipment.

If the cargo is for marine shipment, the fifth step is to place one two-wide-by-two-long array on top of another and couple them to form the maximum array, Configuration 9. At this point, Configuration 9 is transferred for loading on a ship as breakbulk cargo or is transferred to the assembly area for containerized marine cargo.

The container cargo assembly areas for marine and air cargos can be separate or combined, and the empty adaptive pallets are stored there. Furthermore, the breakbulk and container cargo assembly areas can be separate and remote, separate and adjacent, or combined. The final step for containerized cargo assembly is to place three arrays on an adaptive pallet to form an extended array.

Delivery by Helicopter

The configurations used for helicopter delivery will depend on the capacities of the helicopters available. The configurations considered to be best for each of the six maximum loads are listed in Table C3. Although currently used military heavy-lift helicopters can carry Configuration 12 only with less than the maximum payload, it is assumed that future heavy-lift helicopters will be able to carry the maximum static load of 22.4 short tons.

Table C-3. Recommended Configurations for Helicopter Delivery

Quantity of PALCONs	Maximum Static Load (short tons)	Configuration* Preferred
1	0.9	2
2	1.8	5
4	3.6	7
8	7.2	9
12	11.6	11
24	22.4	12

* Configurations are depicted in Table C-1.

Slings are required for the lifting of PALCONs by cranes and helicopters. One type without a spreader is used for lifting Configurations 2 through 9 by the top corners and another type with a spreader, for Configurations 9 through 12 by the bottom corners. Both types are depicted in Figure C-2. The first type has four 11-foot cables, and the second type has four 13-foot cables and an 8-foot spreader.

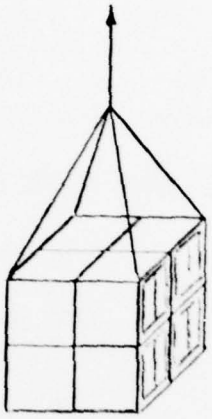
LIMITATIONS IN THE MARINE MODE OF TRANSPORTATION

PALCONs are subject to operational limitations when shipped as containerized cargo by the marine mode, because they do not meet the stacking, racking, and lashing requirements of ANSI containers. Stacking, racking, and lashing capabilities are compromised in favor of tare weight, cargo volume, and cost advantages.

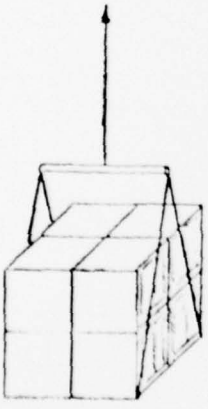
Extended arrays can be stowed above deck as containerized cargo, but only on the top layer, and lashings must be attached to the adaptive pallet, not the PALCONs. Stowage below deck is preferred.

Extended arrays can be stacked below deck as containerized cargo, but either an additional device is needed on the bottom of the stack to redistribute the load or the ship must be modified slightly. To permit stacking without the need for large corner posts, the adaptive pallet has restraint hardware on the bottom as well as on the top to transfer forces directly downward, so that an individual PALCON supports only those directly above it. This special restraint hardware is retractable to meet the bottom configuration requirements of other modes.

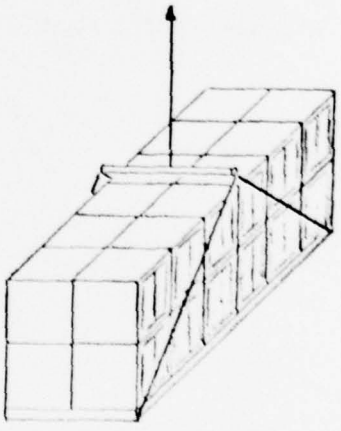
a. Configuration 2 by the top corners.



b. Configuration 9 by the top corners.



c. Configuration 9 by the bottom corners.



d. Configuration 12 by the bottom corners.

Figure C-2. Typical Uses of Slings for Lifting PALCONS

APPENDIX D

CARGO CONTAINER INSERTS

by

Frederick K. Schmidt
1LT, CE

U.S. Army Mobility Equipment Research and Development Command
Annual Training Report
22 September 1977

The need for a new type of Cargo Container Insert has been recognized.[1] [2] This new insert should be:

- Lightweight
- Strong (1500 lb storage)
- Stackable
- Easy to load and unload
- Weather-resistant
- Capable of forward area mission
- Reusable

An attempt to define the parameters for this item for the preparation of a Letter of Requirement (LR), revealed that (according to TRADOC) there was no longer a requirement for this item. An investigation into the chronology of events leads to this action was then conducted. The results, shown in the table (p. 33), are as follows:

1. Aug 75. The first draft of the INTERCON Report[2] was released. The final version (Apr 76) recommends that ". . . a joint TRADOC/USAMC work group be established to prepare a LOA for the design, development, and testing of an improved container insert, or family of inserts . . . ." (p. iii, par. 5c.) It should also be noted that several of the users queried mentioned a need for a container insert with qualities similar to those described above. In particular, these include:

   a. HQ, XMIII Airborne & Fort Bragg (p. B-III-8, par. 2, 3)
   b. U.S. Army Signal School (p. B-V-8, par. 1d, e)
   c. U.S. Army Air Defense School (p. B-IV-8, par. 1d)
   d. U.S. Army Combined Arms Combat Development Activity (p. B-X-9, par. 2D)
   e. U.S. Army Europe & 7th Army (p. B-XI-8, par. 8)
   f. U.S. 8th Army (p. B-XII, par. 3)
   g. U.S. Army Academy of Health Sciences (p. B-XIV-6, par. 3)

2. 22 Aug 75. MERADCOM letter, "Family of Requirement Documents in Support of the Integrated Supply Distribution System (ISDS)." This letter listed container inserts and other items in the ISDS. Addressees were requested to comment on item need requirement document status, priority of the item, and status of any JWG meeting.

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[1] Frederick K. Schmidt, *Container Insert Study*. Annual Training Report. Sep 76.

[2] TRADOC, Intermediate-Size Cargo Container and Associated MHE (INTERCON) – Final Report. TRADOC ACN 22874. April 76.

Cargo Container Inserts – Chronology of Events

1975						1976												1977							
J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S

Hollowform Proposal received.

- 22 Aug – Requirements Document request letter (ISDS)
- 26 Aug – INTERCON draft
- 17 Sep – Transportation School reply received
- 23 Sep – QM School reply received
- 25 Sep – USALOGC summary
- 31 Dec – RDT&E Phase Schedule Report
- 13 Feb – MERADCOM letter (DRXFB-U)
- 1 Mar – Trip to Ft. Lee (USALOGC)
- 22 Mar – USALOGC Review
- Final INTERCON Report
- 8 Apr – Contract awarded to Hollowform
- 1 Jun – Letter from PM announcing letter
- 15 June – Meeting with PM
- 8 Jul – Letter from USALOGC requesting requirements
- 24 Nov – Eight Inserts received from Hollowform
- 9 Dec – Results of USALOGC request
- 19 Jul – Status request from PP&O TRADOC
- 29 Aug – QM reply to request of 19 Jul
- 30 Aug – In-house report on Holform tests
- 6 Sep – Reply from TRADOC to 19 Jul letter

CURRENT STUDY

3. 17 Sep 75. U.S. Army Transportation School replied to the ISDS letter, deferring comment on container inserts to the Quartermaster (QM) School.

4. 23 Sep 75. U.S. Army Quartermaster School reply to ISDS letter stated that a requirement had been identified in the INTERCON draft report of 26 Aug. QM further stated that container inserts would be their first priority upon approval of the INTERCON study.

5. 25 Sep 75. The U.S. Army Logistics Center combined the responses from the QM and Transportation Schools, listing container inserts as priority No. 4.

6. 31 Dec 75. MERADCOM RDT&E Phase Schedule Report. No copy available. Referenced by letter 22 Mar 76.

7. 13 Feb 76. MERADCOM letter (DRXFB-U) to U.S. Army Logistics Center. No copy available. Referenced by letter 22 Mar 76. Subject: "RDT&E and Engineering 3Q76 Reviews."

8. 1 Mar 76. Trip report to USALOGC by J.K. Knaell and E. Rodrick, to discuss the status of pending requirement documents. Cargo container preparation of an LOA for the inserts was projected to commence in April. Final LOA was to be supported by the INTERCON Report.

9. 22 Mar 76. Letter from USALOGC to MERADCOM (DRXFB-U), "RDT&E and Engineering 3Q76 Reviews." This letter lists (par. 3d) Cargo Container Inserts, stating that a JWG will be convened to write an LOA. No dates were mentioned or suggested.

10. Apr 76. Final INTERCON Report published.

11. 1 Jun 76. A letter was sent by Carroll Schipp requesting a requirement document review meeting to be held 15 June at DARCOM.

12. 15 Jun 76. Requirement document meeting at DARCOM. Mr. Schipp stated that all current requirements for container inserts could be met by existing MIL standards or commercial items, and no development was required.[3] However, further user surveys were authorized.

13. 8 Jul 76. Letter from USALOGC was sent to all users, requesting their current requirements for additional container inserts, if any.

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[3] These notes were obtained via a personal conversation with Mr. Morrissett of USALOGC, 19 Sep 77. This information does not agree with meeting report by C.L. Orth dated 18 June.

14. 9 Dec 76. Letter from Mr. Morrissett to PM, "Results of Requirement Request of 8 July 76." Personal conversation with Mr. Morrissett revealed that 13 of the 14 addressees had no requirement for new inserts.

15. 19 Jul 77. MERADCOM letter (DRDME-U) to TRADOC groups, requesting the current status of several requirement documents pending approval. This letter listed Cargo Container Inserts as having an LOA with QM (par. 2r).

16. 29 Aug 77. Reply to the above letter from QM School. Paragraph C refers to the letter from USALOGC of 8 Jul 76, subject: "Requirements for Additional Container Inserts." It states that " . . . no additional inserts were necessary. No further effort is anticipated in this area . . . ." This letter was referenced by Mr. Chandler of MERADCOM in cancelling the Container Insert Project.

17. 6 Sep 77. Letter to MERADCOM (DRDME-U) from TRADOC specifies (par. 2b) that no requirements exist for additional cargo containers.

During my Annual Training Tour (12-23 Sep 77), further investigation revealed:

1. Container Insert Study was listed as a program for FY78 under Project 1X764717DH14, with monies allocated in 6.3 and 6.4 areas, and a validation date of 1Q79 anticipated.

2. The Insert Study was cancelled by the Plans, Programs and Operations (PP&O) Office.

3. Eight rotationally molded container inserts were received and evaluated at MERADCOM. Results were acceptable after minor changes. In-house report of 30 Aug 77 summarized this development.

4. Conversation with Mr. Morrissett indicated that he viewed the container insert project as essentially dead, pending receipt of the rotationally molded insert test report and cost estimate. He anticipated using existing inserts unless the rotationally molded inserts are more cost effective.

In summary, Cargo Container Inserts with internal structural integrity and environmental protection still appear to be needed in combat operation scenarios.[4] However, the users are, perhaps, not aware of the advantages of the proposed inserts and therefore do not list this item as a future requirement. This has resulted in the current inactive status of the Cargo Container Insert Project, as viewed by TRADOC.

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[4] Frederick K. Schmidt, Container Insert Study. Annual Training Report. Sep 76.

One suggestion for alleviating this situation would be to approach the insert program from a marketing viewpoint. Thus, the merits of rotationally molded inserts (for example) could be presented to the end users in an organized, coherent presentation. Responses could then be collected and, if favorable, presented to TRADOC for reconsideration.

Another approach would be for the Mechanical & Construction Equipment Laboratory to initiate its own requirement questionnaire regarding container inserts. The questions could be structured and organized to give the respondent an understanding of the new insert capabilities being proposed. This method would enhance the respondent's innate creativity in recognizing new container qualities. The response, and hence the requirement, should therefore be much more favorable.

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